2.6 Description of table format for S-101 meta and geo features

X.X Clause heading

IHO Definition: **FEATURE:** Definition. (Authority for definition).

S-101 Geo Feature: Feature (S-57 Acronym) S-101 feature type, name and corresponding S-57 acronym

Primitives: Point, Curve, Surface Allowable geometric primitive(s)

Real World	*Paper Chart Symbol*	*ECDIS Symbol*
Example of real world instance(s) of the Feature.	Example(s) of paper chart equivalent symbology for the Feature.	Example(s) of ECDIS symbology for the Feature.

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Category of beer		1 : ale 2 : lager 3 : porter 4 : stout 5 : pilsener 6 : bock beer 7 : wheat beer 8 : pale ale 9 : indian pale ale	EN	1,1
This section lists the full list of allowable attributes for the S-101 feature. Attributes are listed in alphabetical order. Sub-attributes (Type prefix (S)) of complex (Type C) attributes are listed in alphabetical order and indented directly under the entry for the complex attribute (see below for example).	This section lists the corresponding S-57 attribute acronym. A blank cell indicates no corresponding S-57 acronym.	This section lists the allowable encoding values for S-101 (for enumerate (E) Type attributes only). Further information about the attribute is available in Section XX.	Attribute type (see clause X.X).	Multiplicity describes the "cardinality" of the attribute in regard to the feature. See clause X.X.
Fixed date range			C	0,1
Date end	(DATEND)		(S) TD	0,1
Date start	(DATSTA)		(S) TD	0,1

INT 1 Reference: The INT 1 location(s) of the Feature – by INT1 Section and Section Number.

X.X.X Sub-clause heading(s) (see S-4 – B-YYY.Y)

Introductory remarks. Includes information regarding the real world entity/situation requiring the encoding of the Feature in the ENC, and where required nautical cartographic principles relevant to the Feature to aid the compiler in determining encoding requirements.

Specific instructions to encode the feature.

Remarks:

- Additional encoding guidance relevant to the feature.

X.X.X.X Sub-sub-clause heading(s) (see S-4 – B-CCC.C)

Clauses related to specific encoding scenarios for the Feature. (Not required for all Features).

Remarks:

- Additional encoding guidance relevant to the scenario (only if required).

Distinction: List of features in the Product Specification distinct from the Feature.

Feature/Information associations							
Type	**Association Name**	**Association Ends**					
		Class	**Role**	**Mult**	**Class**	**Role**	**Mult**
Aggr Asso Comp	Name of the association (see Section X.X)	**Feature or Information Type at "this" end**	At "this" end	At "this" end	**Feature or Information Type(s) at "other" end**	At "other" end	At "other" end
Remarks: Optional: Any constraints or remarks about the association.							

Remarks:

- S-101 Attribute: Indentation of attributes indicates sub-attributes of complex attributes. Complex attributes may also be sub-attributes of complex attributes, which is indicated by further indentation of the attribute name in the tables.
- S-101 Attribute: Attributes shown in grey text are ECDIS "system" attributes which are populated by the ENC production system in order to assist with portrayal of ENC data in ECDIS (see Section X.X). These attributes may be further edited by the compiler as required.
- S-57 Acronym: S-57 attribute acronyms shown in italic style text have been re-modelled in S-101 from S-57.
- Allowable Encoding Value: For (EN) type attributes, the enumerates listed are only those allowable for the particular occurrence of the attribute relevant to the feature. Allowable values may vary for the attribute depending on the feature to which the attribute is bound. Such bindings are defined in the S-101 Feature Catalogue. The full list of enumerates that may be assigned to an attribute in S-101 can be found in Section XX – Attribute and Enumerate Descriptions – of this document.
- Type: The prefix (C) indicates that the attribute is a complex attribute. Complex attributes are aggregates of other attributes that can be simple type or complex type (see clause X.X). The prefix (S) indicates that the attribute is a sub-attribute of a complex attribute. Complex attributes that are sub-attributes of a complex attribute, and their sub-attributes, are indicated by indentation of the attribute name in the S-101 Attribute column.
- Feature/Information associations/ Type: Is one of the role types association (Asso), aggregation (Aggr) or composition (Comp) (see clause X.X).
- Feature/Information associations/Association name: Is the name of the feature association (see Section X).
- Feature/Information associations/Role: Is the association role (see Section X) for both ends of the association, with the left role as it relates to the feature or information class table.
- Feature/Information associations/Mult: Lists the cardinality of the relationships for both ends of the association, with the left cardinality as it relates to the feature or information class table.
- Example of a feature association: The following extract from the S-101 Application Schema shows the **Island Aggregation** feature association:

For the **Land Area** table entry (see clause X.X) the information association is shown as follows (see also table for **island Group** (see clause X.X) for the corresponding (or reverse) information association entry:

Feature/Information associations							
Type	**Association Name**	**Association Ends**					
		Class	**Role**	**Mult**	**Class**	**Role**	**Mult**
Aggr	Island Aggregation	**Land Area**	Consists of	2,*	**Island Group**	Component of	0,1

3.7 Quality of bathymetric data

IHO Definition: **QUALITY OF BATHYMETRIC DATA**. An area within which a uniform assessment of the quality of the bathymetric data exists. (S-57 Edition 3.1, Appendix A – Chapter 1, Page 1.216, November 2000).

S-101 Metadata Feature: Quality of Bathymetric Data (M_QUAL)

Primitives: Surface

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Category of temporal variation		1 : extreme event 2 : likely to change 3 : likely to change but significant shoaling not expected 4 : unlikely to change 5 : unassessed	EN	1,1
Data assessment		1 : Assessed 2 : Oceanic 3 : Unassessed	EN	1,1
Depth range maximum value	(DRVAL2)		RE	0,1
Depth range minimum value	(DRVAL1)		RE	0,1
Features detected			C	1,1
Least depth of detected features measured			(S) BO	1,1
Significant features detected			(S) BO	1,1
Size of features detected			(S) RE	0,1
Full seafloor coverage achieved			BO	1,1
Horizontal position uncertainty	(POSACC)		RE	1,1
Survey date range			C	1,1
Date end	*(SUREND)*	ISO 8601:2004	(S) TD	1,1
Date start	*(SURSTA)*	ISO 8601:2004	(S) TD	0,1
Vertical uncertainty	*(SOUACC)*		C	1,1
Uncertainty fixed			(S) RE	1,1
Uncertainty variable			(S) RE	0.1

INT 1 Reference:

3.7.1 Quality, reliability and accuracy of bathymetric data (see S-4 – B-297)

Information about quality, reliability and uncertainty of bathymetric data is given using:

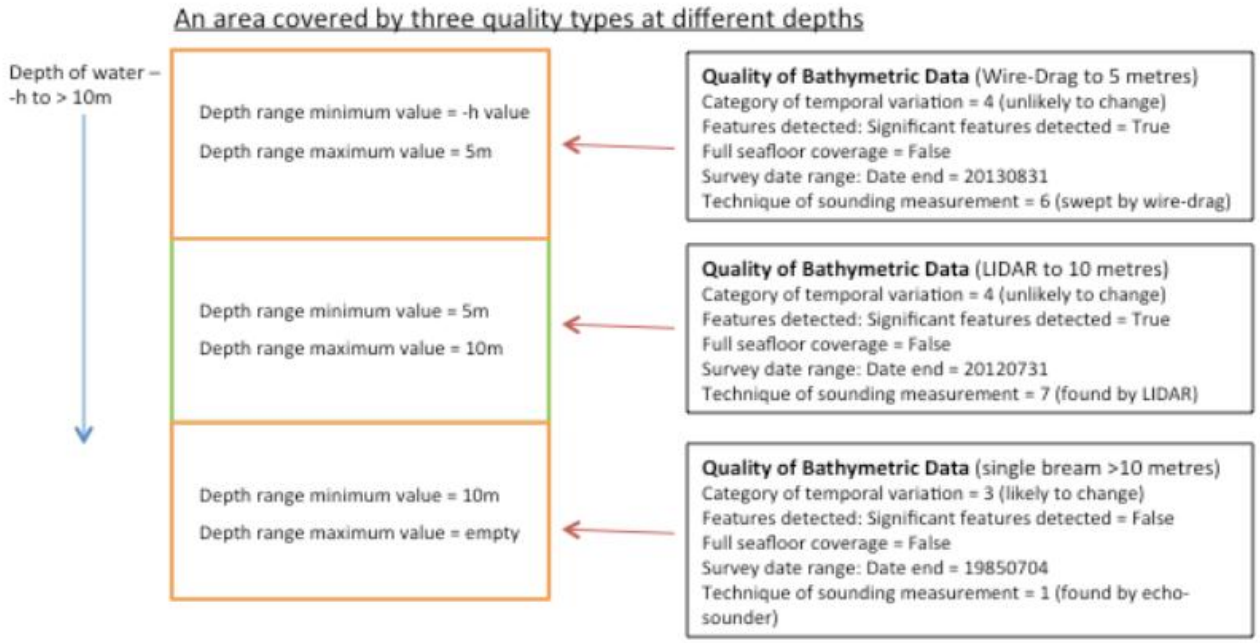
- the meta feature **Quality of Bathymetric Data** for an assessment of the quality of bathymetric data;
- the meta feature **Quality of Survey** for additional information about individual surveys (see clause X.X);
- the attributes **quality of vertical measurement**, **technique of vertical measurement** and complex attribute **vertical uncertainty** on groups of soundings or individual features;
- the attributes **horizontal position uncertainty**, **quality of horizontal measurement** and **category of temporal variation** on the spatial types (see clause X.X).

For the mariner, **Quality of Bathymetric Data** provides the most useful information. Therefore, the use of **Quality of Bathymetric Data** is mandatory for areas containing depth data or bathymetry on ENC datasets at maximum display scale 1:700000 and larger.

More detailed information about a survey may be given using **Quality of Survey** (see clause X.X). For example, in incompletely surveyed areas, lines of passage soundings may be indicated as such using a curve **Quality of Survey** feature. This information is more difficult for the mariner to interpret. Therefore, the use of **Quality of Survey** is optional.

For individual features (wrecks, obstructions etc), or small groups of soundings, **quality of vertical measurement**, **technique of vertical measurement** and **vertical uncertainty** may be used to provide additional information about quality and uncertainty.

The meta feature **Quality of Bathymetric Data** defines areas within which uniform assessment exists for the quality of bathymetric data, and must be used to provide an assessment of the overall quality of bathymetric data to the mariner. Areas of a dataset containing depth data or bathymetry must be covered by one or more **Quality of Bathymetric Data**, which may overlap vertically in order to define the quality of bathymetric data at varying depths in the water column.



Remarks:

- The mandatory attribute **data assessment** provides an overall indicative level of assessment of bathymetric data from which further attribution is derived, and assists with portrayal of bathymetric data quality information in ECDIS:
    - Where the value for **data assessment** is set to *1* (assessed), all additional attribution for the **Quality of Bathymetric Data** feature must be indicative of the quality of bathymetric data for the area.
    - Where the value for **data assessment** is set to *2* (oceanic), all additional attribution for the **Quality of Bathymetric Data** feature should be indicative of the quality of bathymetric data for the area for a mariner's ECDIS pick report, however no portrayal of the quality information will display on the ECDIS.
    - Where the value for **data assessment** is set to *3* (unassessed), the mandatory attributes **category of temporal variation** = *5* (unassessed); **features detected** (**least depth of detected features measured** and **significant features detected**) = *False*; **full seafloor coverage achieved** = *False*; and **horizontal position uncertainty** and **vertical uncertainty** (**uncertainty fixed**) = [empty (null)] must be populated.
- To express completeness of bathymetric data, the complex attribute **features detected** must be encoded. **Features detected** indicates that a systematic method of exploring the sea floor, or the water column to the depth indicated by population of the attribute **depth range maximum value**, was undertaken to detect significant features. The sub-attributes **size of features detected** and **least depth of detected features measured** must not be encoded unless the sub-attribute **significant features detected** is set to *True*.
- Wherever possible, meaningful and useful values for the attributes **category of temporal variation**, **full seafloor coverage achieved**, and the complex attribute **features detected** must be used for areas of bathymetry. For areas of unstable seafloors, the complex attribute **survey date range** (**date end**) must be used to indicate the date of the survey of the underlying bathymetric data.
- **Depth range minimum value** must only be used on a **Quality of Bathymetric Data** feature where a swept area occupies the entire **Quality of Bathymetric Data** surface, or **Quality of Bathymetric Data** features overlap. Where these features overlap such that varying bathymetric data qualities exist at different depths in the water column, the **depth range minimum value** for a **Quality of Bathymetric Data** must be equal to the **depth range maximum value** for the **Quality of Bathymetric Data** feature defining the quality for the level above (see diagram above).
- **Depth range maximum value** must only be used on a **Quality of Bathymetric Data** feature to specify the maximum depth to which all other attributes for the **Quality of Bathymetric Data** feature applies. When **depth range maximum value** is specified, values populated for all other attributes apply only to depths equal to or shoaler than **depth range maximum value**. No quality information is provided for depths deeper than **depth range maximum value**. Where **Quality of Bathymetric Data** features overlap such that varying bathymetric data qualities exist at different depths in the water column, the **depth range maximum value** for a **Quality of Bathymetric Data** must be equal to the **depth range minimum value** for the **Quality of Bathymetric Data** feature defining the quality for the level below (see diagram above).
- **Quality of Bathymetric Data** encoded over **Unsurveyed Area** must have mandatory attributes **data assessment** = *3* (unassessed) **category of temporal variation** = *5* (unassessed); **features detected** (**least depth of detected features measured** and **significant features detected**) = *False*; **full seafloor coverage achieved** = *False*; and **horizontal position uncertainty** and **vertical uncertainty** (**uncertainty fixed**) = [empty (null)].
- **Horizontal position uncertainty** is used on a **Quality of Bathymetric Data** feature to specify the positional uncertainty of the depths covered by the surface.
- **Vertical uncertainty** is used on a **Quality of Bathymetric Data** feature to specify the vertical uncertainty of the depths covered by the surface. When **depth range minimum value** is specified, **vertical uncertainty** refers only to the uncertainty of the swept depth defined by **depth range minimum value**.
- If the attribute **technique of vertical measurement** is required, it must be encoded on either the meta feature **Quality of Survey** (see clause X.X) or on individual geo features (for example **Sounding**).
- When the **Quality of Bathymetric Data** surface contains data from only one survey, the date of survey must be specified using the complex attribute **survey date range**, sub-attribute **date end**. When the **Quality of Bathymetric Data** surface contains data from two or more surveys, the date of the most recent and the oldest survey must be specified using the complex attribute **survey date range**.
- Additional quality information may be given using the meta feature **Quality of Survey**.
- **Quality of Bathymetric Data** areas must not be encoded over land.
- **Horizontal position uncertainty** on the **Quality of Bathymetric Data** applies to bathymetric data situated within the surface, while **quality of horizontal measurement** or **horizontal position uncertainty** on the associated spatial types qualifies the location of the **Quality of Bathymetric Data** feature itself.

- As a result of some disasters, for example earthquakes, tsunamis, hurricanes, it is possible that large areas of seafloor have moved and/or become cluttered with dangerous obstructions. Emergency surveys may subsequently be conducted over essential shipping routes and inside harbours. Outside these surveys, all existing detail is now suspect, whatever the quality of the previous surveys. In such cases, the attribute **category of temporal variation** should be reclassified to value *1* (event), the Boolean attribute **full seafloor coverage achieved** set to *False*, and complex attribute **features detected**, Boolean sub-attributes **least depth of detected features measured** and **significant features detected** set to *False* in the affected areas outside the area covered by emergency surveys.
- Meta features **Quality of Bathymetric Data** and **Quality of Non-bathymetric Data** may overlap.

3.7.1.1 Feature detection

In the context of bathymetry, a feature is any object, whether manmade or not, projecting above the sea floor, which may be considered to be a danger to surface navigation. Refer to S-44.

The ability to detect bathymetric features must be encoded using the complex attribute **features detected**. The sub-attribute **significant features detected** indicates whether the survey was capable of detecting features of a size indicated by the sub-attribute **size of features detected**. The sub-attribute **least depth of detected features measured** indicates whether the least depth of detected features was found. For instance, if a wreck was found, but it is not certain that the least depth of that wreck was measured, **least depth of detected features measured** must be set to *False*.

3.7.1.2 Temporal variation

The changeability of the bathymetry must be encoded using **category of temporal variation**. In order for a time reference to be given for the expression of temporal variation, the relevant dates of the bathymetric data must be encoded using the complex attribute **survey date range** if **category of temporal variation** is set to *1* (event) or *2* (likely to change).

3.7.1.3 Sounding uncertainty

Sounding uncertainty is encoded using the complex attribute **vertical uncertainty** on **Quality of Bathymetric Data**. If it is required to encode additional sounding uncertainty information, it must be done using the complex attribute **vertical uncertainty** on individual geo features (for example **Sounding**).

The uncertainty of sounding must not be encoded using **sounding uncertainty** on the depth geo feature, unless it is different from the value of **vertical uncertainty** encoded on **Quality of Bathymetric Data**.

Distinction: Quality of non-bathymetric data; quality of survey.

3.10 Quality of survey

IHO Definition: **QUALITY OF SURVEY**. An area within which a uniform assessment of the reliability of source survey information exists. (S-57 Edition 3.1, Appendix A – Chapter 1, Page 1.218, November 2000).		
S-101 Metadata Feature: Quality of survey (M_SREL)		
Primitives: Curve, Surface		
Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Depth range maximum value	(DRVAL2)		RE	0,1
Depth range minimum value	(DRVAL1)		RE	0,1
Features detected			C	0,1
Least depth of detected features measured			(S) BO	1,1
Significant features detected			(S) BO	1,1
Size of features detected			(S) RE	0,1
Full seafloor coverage achieved			BO	0,1
Line spacing maximum	(SDISMX)		IN	0,1
Line spacing minimum	(SDISMN)		IN	0,1
Measurement distance maximum			RE	0,1
Measurement distance minimum			RE	0,1
Quality of horizontal measurement	(QUAPOS)	3 : inadequately surveyed 4 : approximate 6 : unreliable	EN	0,1
Quality of vertical measurement	(QUASOU)	1 : depth known 2 : depth or least depth unknown 3 : doubtful sounding 4 : unreliable sounding 6 : least depth known 7 : least depth unknown, safe clearance at value shown 8 : value reported (not surveyed) 9 : value reported (not confirmed) 10 : maintained depth 11 : not regularly maintained	EN	0,*
Scale value maximum	(SCVAL1)	scale value maximum < scale value minimum	IN	0,1
Scale value minimum	(SCVAL2)	scale value minimum > scale value maximum	IN	0,1
Survey authority	(SURATH)		TE	1,1
Survey date range			C	1,1

Date end	*(SUREND)*	ISO 8601:2004	(S) TD	1,1
Date start	*(SURSTA)*	ISO 8601:2004	(S) TD	0,1
Survey type	(SURTYP)	1 : reconnaissance / sketch survey 2 : controlled survey 4 : examination survey 5 : passage survey 6 : remotely sensed 7 : full coverage 8 : systematic survey 9 : non-systematic survey 10 : inadequately surveyed 11 : spot-sounding survey 12 : acoustically swept survey 13 : mechanically swept survey	EN	1,*
Technique of vertical measurement	(TECSOU)	1 : found by echo-sounder 2 : found by side scan sonar 3 : found by multi-beam 4 : found by diver 5 : found be lead-line 6 : swept by wire-drag 8 : swept by vertical acoustic system 9 : found by electromagnetic sensor 10 : photogrammetry 11 : satellite imagery 12 : found by levelling 13 : swept by side-scan sonar 15 : found by LIDAR 16 : synthetic aperture radar 17 : hyperspectral imagery	EN	0,*

INT 1 Reference:

3.10.1 Survey reliability and source of bathymetric data

The survey reliability and/or details of the source surveys used in compilation may be encoded using the meta feature **Quality of Survey**.

Remarks:

- To express completeness of bathymetric data, the complex attribute **features detected** should be encoded. **features detected** indicates that a systematic method of exploring the sea floor was undertaken to detect significant features. The sub-attributes **size of features detected** and **least depth of detected features measured** must not be encoded unless the sub-attribute **significant features detected** is set to *True*.
- If the complex attribute **vertical uncertainty** is required, it must be encoded on either the meta feature **Quality of Bathymetric Data** (see clause X.X) or on individual geo features (for example **Sounding**).
- If the attribute **measurement distance maximum** is set to *0* (zero) for the full area of the survey, the attribute **full seafloor coverage achieved** should be set to *yes*.
- Where populated, the value for the attribute **measurement distance minimum** must not be larger than the value populated for **measurement distance maximum**.
- **Quality of horizontal measurement** on the **Quality of Survey** applies to bathymetric data situated within the area, while **quality of horizontal measurement** or **horizontal position uncertainty** on the associated spatial types qualifies the location of the **Quality of Survey** feature itself.
- The attributes **depth range maximum value** and **depth range minimum value** may be used to define the quality of individual surveys at varying depths in the water column, similar to the method used for indicating the overall quality of bathymetry using **Quality of Bathymetric Data** (see clause X.X).

3.10.2 Quality of sounding

If it is required to encode the quality of sounding, it must be done using the attribute **quality of vertical measurement** on either the **Quality of Survey** or on individual geo features (for example **Sounding**).

The quality of sounding must not be encoded using **quality of vertical measurement** on the depth geo feature, unless it is different from the value of **quality of vertical measurement** encoded on **Quality of Survey** (see tables at clauses X.X and X.X).

3.10.3 Technique of vertical measurement

If it is required to encode the technique of sounding measurement, it must be done using the attribute **technique of vertical measurement** on either **Quality of Survey** or on individual geo features (for example **Sounding**).

Technique of vertical measurement must not be populated with multiple values to indicate the technique of sounding measurement for multiple surveys. **Technique of vertical measurement** may be populated with multiple values only where the area is covered by a survey that has used multiple techniques, for example an area covered by a survey using a modern echosounder combined with a sonar or mechanical sweep system.

The technique of sounding measurement must not be encoded using **technique of vertical measurement** on the depth geo feature, unless it is different from the value of **technique of vertical measurement** encoded on an overlapping **Quality of Survey**; and the information is considered to be important to navigation.

Remarks:

- No remarks.

Distinction: Accuracy of data; quality of bathymetric data

Further information regarding attributes for these meta features can be found in the S-101 Data Classification and Encoding Guide, sections relating to attributes, at: http://iho.int/mtg_docs/com_wg/S-100WG/S-101PT/S101_Data%20Classification%20and%20Encoding%20Guide_Final%200.0.2%20Clean.pdf